INCORPORATING THE USE OF POSTER AND ORAL PRESENTATIONS AS AN ALTERNATIVE ASSESSMENT IN THE TEACHING OF SECONDARY MATHEMATICS

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ABSTRACT

In this classroom research study, an investigation on the use of poster and oral presentations in a Mathematics classroom was conducted in one of the secondary schools in Brunei Darussalam. Specifically, investigating the effect it had on students' understanding and their mathematical knowledge. Each group of students were asked to work together to make a poster on the subtopic they were assigned followed by presenting it to the class. Students were given pre-test prior to the ‘project’ (poster and oral presentations) and a post-test after. The mean of the pre-test of the whole class were found to have improved from 29.80 to 67.05 in the post-test, which is an increase by 37.25, showing a significant improvement and providing evidence for the positive impact of using poster and oral presentations on students' understanding and mathematical knowledge. Students were also surveyed regarding their perceptions and attitudes towards the use of these kinds of project in the mathematics classroom. Even though, 65.4% of the students enjoyed working on the Mathematics poster and oral presentations, followed by 88.5% of the students believed that doing Mathematics poster and oral presentations helped them to learn Mathematics, only 34.6% of the students preferred having poster and oral presentations in the subsequent lessons.

Field of Research: Poster and oral presentations, perception and attitudes, secondary mathematics.

1. Introduction

One of the rationale for implementing SPN 21 (Sistem Pendidikan Negara Abad Ke-21) in Brunei Darussalam was to raise students' achievement in mathematics because it is highlighted as one of the critical skills for the 21st century (Ministry of Education, 2007). However, mathematics is a core subject in which many students often perform poorly throughout primary and secondary schools in Brunei Darussalam. Often, from our observations, the common practice in Brunei Darussalam is to prepare students heavily for tests which, in return may not foster deep learning. Students were not only becoming comfortable as passive recipients of knowledge but they may neglect the importance to be critical by means of discussion and questioning facts given to them. According to NCTM (2000), developing students' communication skills is one of the main goals of the mathematics educations. They believed that teachers have the power to encourage and determine the success of students' communication in any class.
During the first author’s school placement experience in the Master of Teaching program under Universiti Brunei Darussalam, she was given the opportunity to teach two Mathematics classes consisted of lower sixth form (or Year 12) students. The first author had observed that the rate of homework submission was deteriorating over time. Most of the homework was given to students with the intention of strengthening students' conceptual understanding of the topic. However, it might be too lengthy, dull and repetitive which then shifts its focus more onto computational and procedural skills. With the unfavorable homework submission rate, there is a need for an innovative approach to assess students' understanding. Prior to this research, those students were assigned daily homework, assignments and a test at the end of each topic, which put too many emphases on written tests. Therefore, in this research, we focused on incorporating poster and oral presentations into mathematics teaching and learning. In this study, we define ‘project’ as the poster and oral presentations carried out by the students. Each group of students was required to conduct the project. It was hoped that the project could be incorporated as learning tools for students in order for them to have the learning opportunity to develop both their written and oral communication skills. Furthermore, conducting the project may deepen their understanding and strengthen their knowledge on the topic.

2. Research Objectives and Questions

The main aim of this research is to investigate the use of using poster and oral presentations with regards to students' understanding, in a mathematics classroom in one of the secondary schools in Brunei Darussalam. There are two research questions used to guide this study:

1. What are the impacts of using poster and oral presentations on students’ understanding and mathematical knowledge?
2. What are students' perception and attitudes towards the use of poster and oral presentations in mathematics classroom?

The objective of this research is to develop as well as to increase students' level of mathematical understanding within a given topic. Additionally, we hope the students will equip themselves with valuable skills such as being independent learners and confident in voicing out their opinions to the teacher or the whole class during any mathematics lessons.

3. Theoretical Rationale

The theoretical background of this research is drawn upon two major theorists: Constructivist and Multiple Intelligence. The theory of constructivism is generally attributed to Jean Piaget, where he believed that knowledge is not about the learners' ability to memorise facts given by the teachers, but instead knowledge is the ability to transcend the information given into a broader or improved understanding of material. Brooks and Brooks (1993) stated that “one very powerful way students come to change or reinforce conceptions is through social discourse” (p. 108). By encouraging students to engage in dialogue, both with the teachers and with one another, a communicative culture can be fostered and will encourage an effective meaningful sharing of information and learning. Constructivism transforms the student from a passive recipient of information to an active participant in the learning process.

The theory of multiple intelligence claims that different students have different learning styles, strengths and experiences, and not all students learn in the same way (Brooks & Brooks, 1993; Adam, 2000). Therefore teachers should be trained to deliver lesson in multiple ways such as using cooperative learning and projects, so that students are provided with a multitude of learning opportunities, including written and verbal communication opportunities.
4. Literature Review

The National Council of Teachers of Mathematics stated that “in recent decades, psychological and educational research on the learning of complex subjects such as mathematics has solidly established the important role of conceptual understanding in knowledge” (NTCM, 2000, p. 20). However, in most cases, students were more eager to get to the formula and ignorant of the process or proof that would develop the understanding of the conceptual ideas. Butty (2001) suggested that teachers give students the opportunities, encouragement, and assistance in order for students to engage in critical thinking, reasoning, and sense making in mathematics. He believed that consistent engagement in such thinking practices should lead to a deeper understanding of mathematics as well as increased ability to demonstrate complex problem solving, reasoning, and communication skills upon assessment of learning outcomes.

Sobanski (2002) stated that regardless of which side of your brain is more dominant, it is important to keep both sides actively involved in the learning process in order to make the most of your brain. She stated that while “the left brain is good at processing symbols and is very logical and mathematical” (p. 3), the right brain is colour-sensitive, creative and good at processing visual thing. With the use of bright colours in displaying Mathematics onto a poster, it will stimulate the right side of the brain and help in the memory retention and recall. Fan and Yeo (2007) defined oral presentation as “an activity of sharing ideas and clarifying understanding verbally” (p. 83). This is in line with NCTM (2000), where they emphasised the importance of establishing “a communication-rich classroom in which students are encouraged to share ideas and to seek clarification until they understand” (p. 270). The findings from these studies revealed that the use of poster and oral presentation as a medium to incorporate and engage skills such as conceptual understanding, collaboration, interaction with peers and communication had shown positive results for the primary school students as well as the University students.

5. Methodology

5.1 Sample and Data Collection Method

The research site is a secondary school located in the Brunei-Muara district. The sample consisted of 28 lower sixth form students within the age range of 15-16 years old. These students are of mixed gender and abilities. Before the commencement of data collection, permission and approval had been sought from the relevant authorities. In addition, verbal instructions were also given to the research participants on the ethical requirement and rules regarding their involvement in this research. The topic on function was chosen and the next step was to familiarise students to the concept of project (poster and oral presentation). The amount of homework was purposely reduced to enable students to have the opportunity and time to explore further on the topic themselves during the conduct of the project. For the actual data, the students were given a pre-test on trigonometry. It should be noted that the questions on the pre-test and post-test are identical. The tests were designed to include questions which would test the students’ understanding on most of the concepts under trigonometry.

Subsequently, two lessons were used to teach the material. The students were given the flexibility of forming their own group which had led to single sex groupings. The 15 girls divided themselves into 3 groups of five, while the 13 boys divided themselves into 2 groups of six and seven respectively. Within their own groups, they started to conduct their project on trigonometry. Subsequently, two lessons were used for each group to deliver their oral presentations. This was followed by a post-test and a questionnaire in the subsequent lessons. Figure 1 below represents the sequence of the administration of the research study.
5.2 Instrumentation

The data collected were students’ test grades from the pre- and post-tests, students’ responses from the questionnaire and the first author’s personal journal regarding her observations and notable occurrences in the classes. She also recorded the lessons where the students prepared their posters and delivered their oral presentations. These data were mostly analysed quantitatively. Statistical bar graphs of pre- and post-tests were used to provide visual comparison of the performance of each student. Descriptive statistics such as the mean and standard deviation of the pre- and post-test grades provided a broader view on the performance of the whole class. Paired t-test was conducted to check if there were any significant differences between students’ performance in the pre- and post-tests.

The questionnaire was taken from a study conducted by Fan and Yeo (2007). The questionnaire was originally used to investigate students’ general perceptions and attitudes toward the use of oral presentations in a mathematics classroom. However, since this research investigated on the use of both poster and oral presentations, the questionnaire was then modified to include the use of poster as well. The 16 questionnaire items were specifically designed which consisted of three aspects: (a) beliefs in the usefulness, (b) perceptions about their own ability to perform, and (c) acceptance of the project tasks (conducting the poster and oral presentations). The first aspect comprised of nine items, the second aspect five items and the third with two items. A nine-point Likert Scale was used for the questionnaire item in the original study. However, for this research, a six-point Likert scale was used ranging from “disagree totally” to “agree totally” and eliminated the midpoint response. The data from the questionnaire were analysed using quantitative methods. Descriptive statistics, such as percentage, was used to describe students’ perceptions about their own ability to perform, beliefs in the usefulness, as well as their acceptance of the project tasks.

6. Finding & Discussions

6.1 The Impact of using Poster and Oral Presentations on Students’ Understanding and Mathematical Knowledge

Figure 2 below shows the statistical bar graph of the pre- and post-test grades of each student. The mean of the pre-test for the whole class had improved from 29.80 to 67.05 in the post-test, an increase of 37.25. The paired t-test gave a high significance level of $3.05 \times 10^{-9}$, which provided evidence that students’ understanding and mathematical knowledge on trigonometry had increased. However, we do acknowledge that the increase in the post-test might not be the full direct effect of having poster and oral presentations in the lessons. There were other factors involved such as classwork and homework given prior to the post-test as well as self-revision by the students.
Presented next are vignettes of the first author’s personal observations during the assessment of the respective groups’ projects. The oral presentation of the first group of students was very much disorganised. And they did not exactly deliver their intended content. Instead of researching on transformation under trigonometry, they presented transformation of graph. However, they had presented the opportunity for constructing knowledge, linking new knowledge with their previous knowledge. The first group was encouraged to connect between the two topics. Only one or two students were able to do this which in a way proved their conceptual understanding of the given task. One of the students in the group came forth and enquired whether they did it incorrectly. Eventually, the group came to a realisation on what to focus on and they became more engaged in interesting discussions in trying to make sense of Mathematics.

During the second group presentation, it was observed that one of group members had difficulty to interchange between degree and radian. In a way he gave a snapshot to his thinking when he gave up almost immediately on trying to figure out the task in hand and immediately moved on to what was easy for him. This came as a surprise because he usually did really well in homework and tests. There was one student in the second group who made a distinctive impression in his presentation skills. The first author wrote in her journal “Student A impressed me with his presentation skills. If I did not know his academic background, I would assume he is very good in Mathematics”. It was revealed that he was really good at public speaking and teaching his peers. Prior to this, he usually scored around 60% in his tests assuming he was one of the average students. However, he scored 93.3% in his post-test (from 21.4% in pre-test) and became one of the top scorers for the particular topic. It was concluded that his method of learning may be best with this kind of project work. Similarly, another student, student B from the third group also showed similar characteristics as student A. She had good presentation skills and had done averagely in previous tests. Surprisingly, she scored 73.3% in the post-test from a 0% in the pre-test. This group also tried to engage the other peers by asking questions at the end of the presentation in which the class was not too reluctant to respond to. The little act in questioning and responding was wonderful to see because we believed this was the starting point in cultivating the culture of having fruitful discussions among the students and hopefully over time, students may not even need the teacher to start or facilitate any future discussions.
There were two students, student C and student D, in the final group that typically almost never hands in their homework. Therefore, this project gave them the opportunity to be involved and actually do the work. During their presentation, Student C did well in her explanation using loud, clear and confident voice which were lacking in some of the students. Prior to the project, it was assumed that student C was very lazy and unmotivated to do homework but she had the potential to achieve a good score in this subject. Overall, some parts of the presentations did not meet the set expectations. It was hoped that students were more analytical about the data they presented, rather than copy, paste and inform their findings to the class. It was envisaged that students were able to develop their own conceptual understanding. Since this was only the second try that the group carried out the project, it did give the opportunity to identify certain criteria about the project that need improvement. It was concluded that a clearer set of instructions will be needed in the future and perhaps, to plan different types of presentations for students to deliver. This being said, there were significant differences between students’ performances in the pre- and post-tests.

6.2 Students’ Perception and Attitudes towards the use of Poster and Oral Presentations

There were 16 questionnaire items designed to measure the three aspects of (a) beliefs in the usefulness, (b) perceptions about their own ability to perform, and (c) acceptance of the project tasks (conducting poster and oral presentations). It was found that all of the three aspects have high Cronbach Alpha reliability coefficients of 0.793, 0.793 and 0.707 respectively.

The results in Table 1 revealed that students responded positively to all the items regarding beliefs in the usefulness of poster and oral presentations. For instance, in Q3, 42.31% of the students responded ‘agree a little’, 34.62% on ‘agree a lot’ and 11.54% on ‘agree totally’. A total of 88.5% of the students ‘agreed’ and believed that ‘doing Mathematics poster and oral presentation helps me to learn Mathematics’. A total of 76.92% of the students disagreed that ‘doing Mathematics poster and oral presentation is a waste of time’. Note that the value 76.92% originated from adding the three values of 26.92%, 26.92% and 23.08% for ‘disagree totally’, ‘disagree a lot’ and ‘disagree a little’ categories respectively. Meanwhile for Q5, 92.3% of the students believed that ‘doing math poster and oral presentation helps me to be aware of my understanding of Mathematics’.
<table>
<thead>
<tr>
<th>General beliefs about poster and oral presentations</th>
<th>Disagree totally</th>
<th>Disagree a lot</th>
<th>Disagree a little</th>
<th>Agree a little</th>
<th>Agree a lot</th>
<th>Agree totally</th>
</tr>
</thead>
<tbody>
<tr>
<td>3. Doing Mathematics poster and oral presentations helps me to learn Mathematics.</td>
<td>0.00</td>
<td>0.00</td>
<td>11.54</td>
<td>42.31</td>
<td>34.62</td>
<td>11.54</td>
</tr>
<tr>
<td>5. Doing Mathematics poster and oral presentations helps me to be more aware of my understanding of Mathematics.</td>
<td>0.00</td>
<td>0.00</td>
<td>7.69</td>
<td>34.62</td>
<td>42.31</td>
<td>15.38</td>
</tr>
<tr>
<td>6. Oral presentations skill is important in Mathematics learning.</td>
<td>0.00</td>
<td>7.69</td>
<td>15.38</td>
<td>38.46</td>
<td>19.23</td>
<td>19.23</td>
</tr>
<tr>
<td>7. I am able to express about my feeling through Mathematics poster and oral presentations.</td>
<td>11.54</td>
<td>11.54</td>
<td>23.08</td>
<td>38.46</td>
<td>11.54</td>
<td>3.85</td>
</tr>
<tr>
<td>8. I am able to tell others about my understanding of Mathematics through Mathematics poster and oral presentations.</td>
<td>0.00</td>
<td>3.85</td>
<td>19.23</td>
<td>23.08</td>
<td>34.62</td>
<td>19.23</td>
</tr>
<tr>
<td>10. Doing Mathematics poster and oral presentations makes me think broader and deeper about Mathematics.</td>
<td>0.00</td>
<td>7.69</td>
<td>3.85</td>
<td>30.77</td>
<td>34.62</td>
<td>23.08</td>
</tr>
<tr>
<td>12. Looking and listening to other classmate poster and oral presentations are helpful for me in learning Mathematics.</td>
<td>0.00</td>
<td>11.54</td>
<td>7.69</td>
<td>30.77</td>
<td>34.62</td>
<td>23.08</td>
</tr>
<tr>
<td>15. Doing Mathematics poster and oral presentations makes me learn Mathematics better.</td>
<td>0.00</td>
<td>7.69</td>
<td>0.00</td>
<td>61.54</td>
<td>11.54</td>
<td>19.23</td>
</tr>
</tbody>
</table>

The results in Table 2 revealed that students responded positively to all the items regarding their perceptions about own ability to do oral presentations and making poster. For instance, in Q4, 84.6% of the students agreed to the statement 'I am not afraid of doing Mathematics poster and oral presentation'. In Q13, 69.2% of the students believed that they 'can do Mathematics poster and oral presentation well'. However, for Q9, students' responses were equally divided where half of the students agreed to the statement 'I don’t know how to get started when I am doing Mathematics poster and oral presentation'. It can be concluded that there should be the need to give better instructions and guidance to the students in the future.
Table 2: Perceptions about own ability to do oral presentation and making poster (in %)

<table>
<thead>
<tr>
<th>Perception about own ability to do oral presentations and making poster</th>
<th>Disagree totally</th>
<th>Disagree a lot</th>
<th>Disagree a little</th>
<th>Agree a little</th>
<th>Agree a lot</th>
<th>Agree totally</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 Doing Mathematics poster and oral presentations are easy to me.</td>
<td>0.00</td>
<td>7.69</td>
<td>23.08</td>
<td>38.46</td>
<td>19.23</td>
<td>11.54</td>
</tr>
<tr>
<td>4 I am not afraid of doing Mathematics poster and oral presentations.</td>
<td>0.00</td>
<td>11.54</td>
<td>3.85</td>
<td>34.62</td>
<td>26.92</td>
<td>23.08</td>
</tr>
<tr>
<td>9 I don’t know how to get started when I am doing Mathematics poster and oral presentations.</td>
<td>30.77</td>
<td>3.85</td>
<td>15.38</td>
<td>26.92</td>
<td>15.38</td>
<td>7.69</td>
</tr>
<tr>
<td>11 I feel lost when I am doing Mathematics poster and oral presentations.</td>
<td>26.92</td>
<td>34.62</td>
<td>11.54</td>
<td>19.23</td>
<td>3.85%</td>
<td>3.85</td>
</tr>
<tr>
<td>13 I can do Mathematics poster and oral presentations well.</td>
<td>3.85</td>
<td>15.38</td>
<td>11.54</td>
<td>50.00</td>
<td>11.54</td>
<td>7.69</td>
</tr>
</tbody>
</table>

Although students responded positively for the two aspects above, the results in Table 6 indicated otherwise. The students had mixed responses towards the acceptance of the tasks. For instance, in Q1, 65.4% of the students agreed that they ‘like to do Mathematics poster and oral presentations during Mathematics lesson’. However, only 34.6% of the students ‘would like to have more Mathematics poster and oral presentations for my Mathematics lessons’. Although they may enjoy doing the tasks and believed in the usefulness, students might possibly be burnt-out from having two sets of poster and oral presentations done in a period of less than two months. This might have led students responding negatively towards the above statement. The intention was not to implement this kind of students’ project on a regular basis, which the student may have assumed as well.

Table 6: General acceptance towards oral presentations and making poster (in %)

<table>
<thead>
<tr>
<th>General acceptance towards oral presentations and making poster</th>
<th>Disagree totally</th>
<th>Disagree a lot</th>
<th>Disagree a little</th>
<th>Agree a little</th>
<th>Agree a lot</th>
<th>Agree totally</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 I like to do Mathematics poster and oral presentations during Mathematics lesson.</td>
<td>7.69</td>
<td>0.00</td>
<td>26.92</td>
<td>42.31</td>
<td>23.08</td>
<td>0.00</td>
</tr>
<tr>
<td>14 I would like to have more Mathematics poster and oral presentations for my Mathematics lesson.</td>
<td>7.69</td>
<td>19.23</td>
<td>38.46</td>
<td>19.23</td>
<td>7.69</td>
<td>7.69</td>
</tr>
</tbody>
</table>

7. Conclusion

There had been great emphasises placed upon student-centered approaches, with teachers moving away from an ‘instructional paradigm’ to a ‘learning paradigm’ (Foster, 2008). Foster further stated that the core of the learning paradigm, “has been the notion that people learn best when they are engrossed, engaged and motivated to seek out new knowledge and skills” (Foster, 2008, p.149). The typical classroom settings for these Mathematics lessons had always prioritise in enhancing students writing and procedural skills by doing a lot of exercise questions and tests. Students were comfortable not to be involved in the active learning process by means of questioning, discussing and explaining their thought processes. The word ‘oral presentation’ came as a shock to these students when they were first introduced to this project. One of the students thought that presenting...
Mathematics meant they had to search for the history of the topic and presenting it. This was not the intention of having the project in the first place. By requiring the students to produce poster and present it orally, it increased students’ involvement in class and made them accountable for their learning. These tasks eliminated the previous problems encountered beforehand which were students choosing not to hand in their homework or simply copying the answers from their friends.

The comparisons between students’ pre- and post-test results in this study provided significant evidence that students’ understanding and mathematical knowledge had increased with the implementation of the students’ project. Even though students’ mathematical communication skills were not evaluated, it was hoped that by implementing the project would have created a different and new environment where students were able to communicate openly. While getting good results is important, students should also realise that the process and the understanding are just as important and useful in the long run. The students were given the opportunity to do these kinds of projects so that they will eventually get used to explaining Mathematics verbally which is also crucial in learning Mathematics, regardless of the year levels they are currently in. Time constraints and the small sample size were among the limitations of this study. If time was not a factor, it would have been advisable to observe the long term effect it may have on the students. And also to investigate further whether any difference was achieved in the way they approach and learn Mathematics in general.

8. Implications and Recommendations

We believe that Mathematics lessons should not put too much focus on the writing skills that students forget about the element of being able to talk and explain the Mathematics they are writing. Based on the findings from this research, students should be encouraged and given the opportunity to do poster and oral presentations by their Mathematics teachers in an attempt to create and improve the learning environment. Primary and secondary level students are more familiar with these kinds of projects but unfortunately becoming less of a norm when they go to higher levels. Students should continually be exposed and willing to take part in doing poster and oral presentations from an early age and throughout secondary and university levels. By partaking in such tasks, students will consistently and actively be involved and be responsible for their own learning. Involving poster and oral presentations in teachers’ lesson planning may provide an innovative substitute to the excessive amount of homework given.

Findings from this research indicated that the students responded positively to this kind of project. While it may seem unnatural especially to some students and teachers to incorporate poster and oral presentations in their Mathematics lessons, it embraces the various different ways that students learn. It also gives students the opportunity to have more practice and be more competent in their English language skills, which may have an effect on their performance in Mathematics. It is important to note that not only is this research a small scale study conducted within a short period of time, it also focuses on an elite school in the nation. The outcome of this research may not be identical if it is to be administered to other schools in Brunei Darussalam. It is recommended that instead of poster and oral presentations, students may prefer to have poster sessions where groups of students stand beside their respective posters to explain the content of the poster to someone who visits their booth. Currently, poster sessions are more popular among University students. Nonetheless, primary and secondary students should also be encouraged to set up poster sessions during any Mathematics events in their school.
References


